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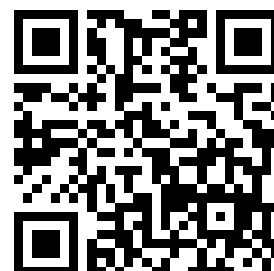
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Supplement on

# A RESEARCH... and the COMMUNITY



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# PROGRAM OF THE SYMPOSIUM ON "RESEARCH AND THE COMMUNITY"

Held May 1, 1961 at Sterling Forest, under the auspices of the New York State

ADVISORY COUNCIL  
FOR THE

ADVANCEMENT OF INDUSTRIAL  
RESEARCH AND DEVELOPMENT

## TOPIC I PROBLEMS OF HIGHER EDUCATION AND TRAINING

### *Keynote Speaker*

DR. FREDERICK E. TERMAN, Provost  
Stanford University, Stanford, Calif.

### *Panel of Discussants*

DR. JOHN R. DUNNING, Dean  
School of Engineering  
Columbia University, New York, N. Y.

DR. WILLIAM O. BAKER  
Vice President for Research  
Bell Telephone Laboratories  
Murray Hill, N. J.

DR. CARL W. BORGMANN, Director  
Science and Engineering Program  
Ford Foundation, New York, N. Y.

## TOPIC II PROBLEMS OF PHYSICAL ENVIRONMENT

### *Keynote Speaker*

MR. GEORGE A. DUDLEY  
Harrison & Abramovitz, Architects  
New York, N. Y.

### *Panel of Discussants*

MR. THOMAS M. LINVILLE, Manager  
Research Operation Department  
General Electric Company  
Schenectady, N. Y.

MR. JAMES FELT, Chairman  
New York City Planning Commission  
New York, N. Y.

MR. E. S. HOWARTH, Chief Engineer  
Alcoa Research Laboratories  
New Kensington, Pa.

### *Luncheon*

### *Addresses*

GOVERNOR NELSON A. ROCKEFELLER, Presiding

MR. ROBERT W. DOWLING, President  
City Investing Company  
New York, N. Y.

DR. JESS H. DAVIS, President  
Stevens Institute of Technology  
Hoboken, N. J.

## TOPIC III SOCIAL PROBLEMS

### *Keynote Speaker*

DR. MARGARET MEAD, Secretary  
Institute for Intercultural Studies  
New York, N. Y.

### *Panel of Discussants*

DR. RICHARD G. FOLSOM, President  
Rensselaer Polytechnic Institute  
Troy, N. Y.

DR. JOHN DYCKMAN  
Associate Professor  
Institute for Urban Studies  
University of Pennsylvania  
Philadelphia, Pa.

DR. S. BERNARD WORTIS, Dean  
New York University Schools of  
Medicine, New York, N. Y.

## TOPIC IV ECONOMIC PROBLEMS

### *Keynote Speaker*

DR. HENRY BUND, Vice President  
The Research Institute of America  
New York, N. Y.

### *Panel of Discussants*

DR. HECTOR R. SKIFTER, President  
Airborne Instruments Laboratory  
Deer Park, Long Island, N. Y.

DR. GERHARD COLM, Chief Economist  
National Planning Association  
Washington, D. C.

DR. THORNTON L. PAGE, Director  
Van Vleck Observatory, Wesleyan  
University, Middletown, Conn.

MR. DAVID ROCKEFELLER, President  
The Chase Manhattan Bank  
New York, N. Y.

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# RESEARCH... and the COMMUNITY

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## FOREWORD

DR. CLIFFORD C. FURNAS

Formerly research - like babies - seemed to just happen. That concept began to change around the turn of the century when various organizations, including some industries, discovered that organized and planned research was capable of bringing about great and, often, unanticipated benefits.

Research in all scientific fields budded and expanded at a substantial pace during the twenties and thirties and then burst into full flower with the approach of World War II. It is conceded that the Western Allies were able to win that contest primarily because of the concentrated and effective research on new weapon systems by the Americans, Canadians and British.

Contrary to the forecasts of many, scientific research did not sink into a valley after the end of hostilities; rather it began climbing toward new heights and is still rising with no immediate plateau in sight. The volume of research and development in America is now approaching \$15 billion per year. That makes it big business. However, it is not the dollars going into research which are of primary importance; rather it is the impact of the forthcoming product - new knowledge in nearly all fields.

During the past decade it has become crystal clear that the economic and cultural health of a region or major community depends more on the amount and effectiveness of the research efforts at its core than on any other single factor. Realizing this, Governor Rockefeller in December 1959, guided and aided by Commissioner of Commerce Keith McHugh, established a New York State Advisory Council for the Advancement of Industrial Research and Development.

To this body he appointed forty-three men who represent a very broad spectrum of research interest and accomplishment. The roster, which appears

on the back cover, includes research executives from industries, university administrators, research institute directors and appropriate government officials. It is a cooperative, cosmopolitan body of unusual strength and acuity.

The purpose of this Advisory Council is "... to improve the climate for and to advance the growth of industrial research and development and to encourage more research activity and more research-oriented industry in New York State." From its first meeting there was almost complete unanimity of opinion that research for New York State could best be advanced by a community of effort involving education, industry and government. The phrase "research and the community" came up repeatedly in Council discussions. It was quite natural, then, that the suggestion should be made and adopted that an open meeting be held on that general topic. As a result a "Symposium on Research and the Community" was held at Sterling Forest, New York, on May 1, 1961.

Great credit should go to the Committee which not only arranged the details of the meeting, but by persuasion and other forms of salesmanship, assembled a most outstanding list of keynote speakers and panelists. The names of these are listed inside the front cover. All thanks to them. Heartfeld thanks, too, to Mr. Robert W. Dowling, President of City Investing Company, and to Mr. Samuel R. Walker, President of the Sterling Forest Corporation, who extended the hospitality of the Sterling Forest research community to the participants of the Symposium.

It is certain that the one hundred and fifty persons who attended this Symposium, which afforded an opportunity for free-wheeling discussion

of fresh ideas, felt that it pointed the way toward an ever-more dynamic and vital future for New York State - and the Nation. May the readers of these pages capture some of this same feeling and carry on from there.

C. C. Furnas

Chairman, Advisory Council for  
the Advancement of Industrial  
Research and Development



## PREFACE

DR. PAUL A. WEISS

The Symposium on "Research and the Community" is symbolic of the efforts of modern man to supplant informed and intelligent foresight for the blind and hazardous game of evolution by sheer trial and error. Research has become a major national occupation and asset, large in volume, even larger in significance. Our national outlay for research and development is now of the order of 15 billion dollars annually, and it keeps growing at an increasing rate. It has reached, or is about to reach, the "critical mass" at which it passes from an isolated and independent enterprise into an affair of broad concern to the community, having either grown up to that stage gradually or been thrust upon a community rather massively and abruptly. For such a transition to take place not only without stress and frictions, but, on the contrary, with mutual benefits emerging for both the research establishments and the communities, requires foresight, based on insight into the nature of their inter-relations. Insight comes from experience. But since experience rests on past precedents, unprecedented situations cannot be mastered by recourse to familiar formulae.

The phenomenon of the current "research explosion" is unprecedented. To meet its needs, its hazards and its potentialities, therefore, requires that at least all available bits of experience that might be applicable be collected and evaluated in concert; for the rest, one must reason from analogies, and even then, a lot is still left to guesswork. It is the object of intelligent planning to reduce this last component to a minimum. To solve a problem, one must first know it. To get to know it in the present case, means to obtain, first, an inventory of the component issues

into which it can be broken down, and second, some idea of the nature and intricacy of their interplay. It probably will turn out then that many of the components as such are quite familiar from past experience and that it is only the unprecedented intimacy and rate of their interplay which present novel problems. This seems to be, indeed, the case in the interplay between research and the community.

Perhaps, in setting research and the community in opposition, as the title does, one misstates the problem. For, after all, research is done in communities by members of communities. It is, or should be, an integral part of community life, contributing to it as well as benefiting from it. And what this conference really set out to do was to explore the state and future of this integral existence in an age of expanding research and changing community structure.

Communities are like organisms. Every organism is an integrated whole. This means that it can live and function only as long as all its vital parts are adjusted to each other. Their structures and activities must mesh, like gears, in such a calculated manner that their combined effects will maintain the integrity and stability of the whole system in its customary environment. The result, while stable, is not static. The organism grows, and the environment changes. The blueprint for development, therefore, must, on the one hand, anticipate and provide for the needs during the growth phase so that the organism will live to reach maturity, and, on the other hand, still leave enough latitude for the system to adapt itself to moderate environmental fluctuations. These provisions go a long way in keeping a population of organisms with relatively conservative genetic blueprints -- the counterpart of tradition in social affairs -- viable and vigorous, while they undergo their slow and

steady evolutionary progress. Each part, though changeable must only change ever so slightly lest its change upset the total equilibrium of the system; then the other parts can follow suit, likewise in small steps, without major violent disruptions of the evolving pattern. At no time can the change of any part be treated as an isolated event, inconsequential for the integrity and viability of the whole system. All parts hang together in a network of interlocking dependencies, and any departure of any one part from its standard course is apt to affect secondarily all other parts. Such repercussions can be disastrous for the system, unless all affected parts respond promptly and adequately to repair the disturbed harmony. In the evolution of organisms, such incidents, known as "mutations," arise continually, but all those of the resulting aberrations that are unfit for survival are radically eliminated. Only an infinitesimally small proportion of deviants emerges with just the right combination of new adaptive features to remain viable in the new, and mostly improved, form. In going through its paces in this trial-and-error fashion, organic evolution takes its time.

Social patterns, by contrast, evolve on a different time scale, infinitely faster. And this is the crux and rationale of exercises such as the present conference. Communities are indeed like organisms. Their members, groups and activities are similarly enmeshed in a network of interdependencies and interactions, so harmonized by time-tested experience that steady progress consistent with stability has ensued. But the rate of potential progress has been stepped up greatly. Ideas, invention and discovery have taken over the role of genetic mutations, and intelligent evaluation and foresight have given us the means to

short-cut around the slow and often fatal evolutionary practice of testing viability by the actual fact of survival. As innovations now come precipitously, our social system is deprived of the time for adjustment granted to the more sluggish systems of organic evolution. Thus, stresses and strains arise, engendered by the facts that different parts sprint on their own divergent tracks independently or that measures to meet changes in the physical, social, economic and political environment are taken piecemeal without mutual regard. Of course, we, too, could adopt the wait-and-see attitude of organic evolution. But, evidently, we would do better in using our intelligence to counter those stresses by adjustable measures long before they have been allowed to reach the stress limit beyond which the whole structure would be threatened with collapse.

Now, all of this may sound rather commonplace in our day, when the principle of intelligent planning is rather widely accepted as a superior substitute for blind probing. However, the full scope of the principle and the full magnitude of the task of implementing it are not equally widely recognized. Most planning is still done in separate bits, each dealing with an isolated sector of a broader problem or even only with some limited aspects of such a sector. Solutions are the easier to come by, the more narrowly a problem is confined, and over-all solutions, unless just verbal sham, are man's toughest challenges.

Yet, from what I have just outlined, it should be clear that isolated measures in limited sectors, based on conclusions arrived at in separate compartments and with no regard to the broader contest, are not likely to add up to a consistent over-all solution of the total problem at hand, particularly if some of them happen to work at cross purposes. So, what we are doing, in fact, is using intelligence while we are in our various

corners with blinders and then, when it comes to fit the pieces together, we leave the fitting again to the blind gamble of success by accident, abdicating our rational faculties. In other words, by stopping half way in the transition from the blind organic to the rational human methods of progress, we fall short of both our obligations and our opportunities.

It is at this critical juncture that conferences like this one are convoked to overcome the premature stoppage of applying rational insight and foresight to ever more complex problems in ever larger contexts. Research ceases to be an isolated problem area, the requirements of which could be assessed in its own terms; instead it is revealed to be an integral part of a much broader complex of problems, which encompasses such questions as: For whom should it be done? By whom? Where? How much? Should it be concentrated or dispersed more widely? What are the educational, physical, social and economic parameters that condition its pursuit and in ignorance of which such pursuit could not be brought to best fruition? What must it ask of the community in order to thrive, and what, in turn, can it render to the community in values, both tangible and intangible?

Some scattered information and opinions on any of these questions have been available. But never before, it seemed, had all that information been sampled, compared, evaluated, and interrelated on a common platform, under a common perspective and for a common purpose. Naturally, unresolved and vexing as even many of the partial questions are, their cross-correlation and reconciliation in the total picture becomes a task of truly staggering dimensions and difficulty. No more than a first start could be expected from a one-day session, especially since members

from disparate disciplines were brought together, who are not always too conversant with each other's stock of knowledge, terms of reference, concepts and methodology.

Despite such handicaps, however, the meeting was patently successful in attaining three main objectives. In the first place, it spelled out, as in a table of contents, in specific terms, the educational, geographic, physical, sociological, economic and fiscal facts to be taken into consideration: (a) in the continuation and expansion of existing research operations in a community; (b) in the de novo introduction of a major research engagement into a community; and even the reverse, (c) in the development of a new community around a research center as focus. Second, it furnished practical illustrations and documentation for the indissoluble interconnections that exist between these various considerations and indicated the urgent need, as well as the feasibility, of learning to understand them more deeply and to use the understanding thus gained as guide for practical action. The newer methodologies of operations research and of systems study could presumably be of assistance in these efforts. And, third, it made all participants realize that only from a systematically continued conjoint effort among all the disciplines concerned can we hope to arrive eventually at a reasonably safe base of principles, partly rational, partly empirical, from which practical rules for national, regional or local application to the complex issue of "research and the community" could be derived.

In summary, as a first step in that desirable direction, the meeting was a signal event. This is to be credited chiefly to the broad vision and balanced judgment with which the various speakers approached and presented their parts, ably supported and supplemented by the discussants.

They set a splendid example of harmonious cooperation and willing subordination to a common objective. They made the task of the Planning Committee both easy and gratifying. On behalf of the Planning Committee, I express to all of them sincerest gratitude, along with thanks to the members of the Planning Committee, all officials of the State Government, the director and staff of Sterling Forest, and my administrative assistant, Mrs. G. A. Norton, for their effective contributions to a most worthwhile understanding.

Paul Weiss, Ph.D., Sc.D., M.D. (hon.)  
Member and Professor  
The Rockefeller Institute, New York, N. Y.



## HIGHER EDUCATION AND TRAINING IN A RESEARCH COMMUNITY

DR. FREDERICK E. TERMAN

The last twenty years have seen an enormous expansion in the amount of fundamental and applied research being carried on in this country, both by academic institutions and by industry. This began as part of the war effort, at which time it was directed toward aiding our war effort. However, research activity did not decrease once the war was over. Rather it has continued at a steadily expanding rate, and is now far greater in total magnitude than at any time during the war.

There are two reasons for the growth of research after the war. First, peace was not accompanied by a relaxation of international tensions, and it became necessary to maintain the strongest possible military potential. This required the continued improvement of old weapons and development of new weapons.

The second reason for the growing support of research in this country is that it is now widely recognized that what we spend on research is not money gone with the wind, but rather is an investment that brings to the nation a handsome return in the form of greater wealth, higher standards of living, better health, etc., as well as increased military security. Expenditures for research provide the seeds for the future growth of our national economy and of our future military position. Because of such considerations, the federal government has found it desirable to expend large and steadily increasing sums on research, not only through the Department of Defense, but through such other agencies as the National Science Foundation, the Atomic Energy Commission, and the National Institutes of Health.

Concurrently, with this growing national expenditure on research this country has seen a remarkable development of what are commonly termed "growth industries." These are industries that are based on the exploitation of new developments in science and technology; examples are electronics, nucleonics, missiles, computers, chemicals, pharmaceuticals, etc. They are products of a sophisticated science and technology. They grow as a result of new products made possible by recent developments in science and technology. Because of their nature these industries require a disproportionately large number of highly trained individuals whose formal education has extended beyond a bachelor's degree. This training is required to understand the complicated processes and devices involved, and to make contributions to their continued improvement.

The growth industries have received much popular attention in the last few years because of the spectacular financial record that many companies of this type have made. Another reason is a tax structure that makes it easier to accumulate wealth through investment in a growing company than through personal savings from one's income. More fundamentally, however, the growth industries more than anything else, will determine the expansion of our economy in the future and the resulting improvements that will occur in our standard of living. The growth industries are the industries of the future.

Growth industries are especially desirable from the point of view of the community in which they are centered. They are typically, characterized by large numbers of college graduates, many of whom must have advanced degrees, by high levels of skills even in the manufacturing activities, and they generally tend to be clean, attractive, and pleasant. This is the mental image typically associated with the phrase "Industrial Park," or "Research Center."

It is becoming increasingly realized that universities have an important and unique role in relation to those industries that depend on creative applications of new developments of science and technology, i. e., the growth industries. Universities are the sources of the highly trained young men who represent the most important raw material going into creative work. Through their research activities, universities are sources of ideas; some of these ideas are exploitable directly while others contribute to understanding that stimulates innovation. The faculty in the science and engineering departments of a good university represents a panel of experts of widely diverse skills available on a consulting basis to aid industry with its problems; these services are moreover available on terms such that they can be afforded by even a relatively small company. A university close at hand can also provide educational opportunities for employees, whereby bright young men with good potential but inadequate training can be upgraded, and whereby all can be kept abreast of new scientific developments and technological changes. Finally, in an intangible but very real way, a university provides an atmosphere that stimulates creativity, and that also makes a community attractive to scientifically minded individuals.

Industry has discovered that for those activities that involve a high level of creativity of a scientific and technological character, location near a center of brains, that is, near a good educational institution, is more important than location near markets, raw material, transportation, or factory labor. As a result we find that there is today a substantial concentration of research oriented industry associated with some of our best educational institutions, and that nearly every first rate institution is beginning to gather around it at least

some industrial activity of the growth type. The Boston area may be stagnant in many respects, but it is one of the liveliest places in the country for growth industries that are based on a rapidly advancing science and technology. This is easily traceable to the fact that the Massachusetts Institute of Technology and Harvard University are both in the Boston area. In a similar manner, one finds that the California Institute of Technology has provided the stimulus for a number of successful growth companies, and that Stanford University is at the center of a rapidly growing complex of growth industries.

In cases where growth industries have already become established in an area that does not have educational opportunities, it is beginning to be found that this lack is a definite handicap. We see three types of efforts being made to remedy such situations. The first approach is to move the creative portion of the company's work to a community that does have an adequate educational institution.

A second approach is possible when there is an educational institution in the community, but one which lacks the requisite strength in science and technology at graduate level. Here the possibility exists of aiding the school to develop in directions that will meet the need. Thus the growth industries in Phoenix, Arizona, have induced the Arizona legislature to develop an engineering science program through the master's degree at Arizona State College, which is located in a Phoenix suburb. These companies have provided aid that included a substantial amount of cash, installation of a very large computer, and assistance from scientifically qualified members of their technical staffs. Again in San Diego, where there is a large aircraft and missile industry but limited educational opportunities at graduate level, San Diego industry

felt it was under a handicap and undertook to see that something got done. The result is that the University of California has announced it will convert the Scripps Institute of Oceanography to a general university which will place strong emphasis on pure and applied science.

A third way in which growth companies can overcome the handicap of limited educational opportunities is to arrange for the establishment of a branch of a university where the industry is located. Thus the Bell Telephone Laboratories has an agreement with New York University under which the latter operates a branch campus on the Bell Telephone Laboratory's premises. A bona fide program of college instruction is offered which is taught by regular New York University faculty, which carries full college credit, and leads to a degree at New York University. This is not a night school, or a training course in company methods, but rather a graduate program typical of that offered for regular "on campus" students, and which is offered during working hours with attendance in class being on company time. A somewhat analogous arrangement has been established at Hartford, Connecticut, whereby Rensselaer Polytechnic Institute operates a branch campus in that area financed by funds from local industry, and providing graduate instruction at college level in degree programs.

These educational needs of growth industry for an academic neighbor are primarily at graduate level and are largely in the areas of science and technology. A liberal arts school, in which science is limited to undergraduate work, does not meet this need of growth industries, irrespective of the fact that a liberal arts school has many attractive features. Likewise, although the social sciences and humanities are

or should be an important component of the undergraduate training of every engineer and scientist, they do not figure importantly in the educational needs of research oriented industry.

Up to this point the discussion has been concerned entirely with the value of the university to an industrial center. While a university is probably more essential to the strong industrial center of the future than is the industrial center to the university, this is not a one way street by any means. Great educational institutions have much to gain by being near a center of creative industry. The flow of ideas goes both ways, and an alert university strong in science and technology will become still stronger from association with research minded industry. The presence of nearby industry aids the university by making it easier to recruit new faculty members, and to hold the ones that are already available. This is in part through consulting associations that develop in such situations, with resulting favorable effect on the income of academic personnel, and in part through stimulating associations that inevitably develop. A strong industry having friendly relations with a vigorous university also will normally assist the educational program in a variety of ways, including monetary grants, gifts of equipment, cooperation in making available personnel with specialized talents to aid the educational operation on a part time basis, etc. In addition the presence of a research oriented industrial activity in the academic community often results in research knowledge, originated at the educational institution, being exploited in a practical way more rapidly than would otherwise be the case. This increases the impact of the University research on the world, and thereby increases the satisfaction the academic researchers receive from their efforts.

The extensive interactions that exist today between universities, industry, and the scientific activities of the federal government, are such that our educational institutions today are no ivory towers. The college professor of today who is active in a live area of science or technology, will not only be carrying on a substantial research program on the campus, he will also travel an unbelievable number of miles each year, serve on an incredible number of committees sponsored by the government or scientific societies, and may even sit on one or more boards of directors. Today one finds innumerable college professors in Washington advising the President, the Department of Defense, the National Institutes of Health, etc., on scientific matters on either a full time or part time basis. In addition a college professor now chairs the Atomic Energy Commission, other professors negotiate at Geneva with the Russians on the detection of atomic blasts, and so on. The distinguished college professor of today in science and technology is apt to be a man of affairs — a man of the world. As such he has much to contribute to industry.

Graduate programs can be good or they can be poor. Just because a program of study at graduate level is available does not automatically mean that the educational need of a research-oriented community has been satisfactorily met. A good graduate level program should be centered on the academic campus. It should be taught primarily by professional educators who are themselves either active in research or closely coupled to research activities of top caliber. There should be a virile research program being carried in association with the instructional activities, and this program should be run by the faculty men and involve extensive participation by graduate students.

Graduate education at the doctorate level aims to produce men who can learn new things without the aid of a teacher. To achieve this result graduate education and research belong together. The apprentice scientist learns best when he learns in an atmosphere of active research, and actual participation in this research is a necessary part of such education. This requires that the campus be the focus of graduate education, and that the students spend enough time on the campus during their regular working schedule - not as over-time after a full day's work - to make it possible to carry on education as a serious business which progresses towards goals at reasonable speed. Such a program requires adequate financing for the facilities, for the research expenses, and likewise for the faculty time that goes into the educational portion of the operation. It is not possible to run a first-class program of graduate level education in science or engineering on tuition fees alone.

An educational program does not have to be ideal to be useful, since half a loaf is better than nothing at all. At the same time it is well to keep in mind the features that characterize the typical programs that fall far below the ideal. First, such programs are typically underfinanced, i.e., they attempt to cover operating expenses from tuition fees alone, by keeping the seats warm from early in the morning until late at night. Such programs typically also operate with a high component of part-time faculty in place of professional teachers. This saves money but it results in a classroom situation involving amateur professors and professional students. Another characteristic of typical lower level programs is a preponderance of night school students, who go to class in the late afternoon or in the evening after having worked a full day. The academic work of these individuals is thus a strictly overtime

activity, with the students not at their peak either physically or mentally. Night programs have the further disadvantage that it takes as much as four years to complete a master's degree program that would require only nine months in the case of a full time student. Another difference between strong and mediocre programs is that the strong programs normally require that thesis research, particularly at the doctorate level, be done on campus under the direct supervision of the professor and in association with other graduate students who are also working on theses, rather than permitting the research to be done off campus as part of a regular industrial job.

Another feature of the less desirable graduate level programs is a tendency to lower admission standards so that nearly anyone with a B.S. degree and an interest in further study can participate. This results in a heterogeneous group, and makes it impossible to conduct the classroom instruction at the level that would be used for a homogeneous highly selected class. The most attractive arrangement is a high level graduate degree program with high admission standards, supplemented by an entirely separate and distinct extension program catering to lower levels of ability. When a school is underfinanced there is a temptation to lower standards and make the extension work part of the regular degree program in order to swell the enrollment. In such circumstances there is also the temptation to allow the degree program to include courses that serve the immediate needs of a group of constituents. Graduate training leading to an advanced degree preferably educates young people for life-time careers, rather than having as their primary purpose the increase in proficiency for the job of the moment. Instructors for specialized courses can be obtained

inexpensively from industry and when a school is underfinanced, there is a temptation to allow expediency to becloud long range considerations in staffing the program.

Another factor to keep in mind is that an educational operation must be a bona fide education to be effective. A non-profit research center, even though it may contribute very much to its community, is not a substitute for a strong educational center, even when the non-profit research activity is operated by a university.

In conclusion, I will summarize my main points. The last 20 years has seen a great expansion of research in this country, largely stimulated by assistance from the federal government. This has originated in a recognition of the fact that research is essential both to the maintenance of our military security and to the development of our national welfare. Viewed by society as a whole, money spent on research is not an expenditure, but rather an investment that pays big dividends in terms of standards of living, national health, growth of the economy, development of new weapons and improvement of old, etc.

A consequence of this 20 years of intensive research has been a remarkable expansion of industries that grow as a result of new products made possible by recent developments in science and technology. These "growth companies" are an increasingly important segment of our economy, and promise to be the industry of the future.

It has become increasingly clear in the last few years that these growth companies benefit from the proximity of graduate schools of science and technology. As a consequence, many university communities

are now in the process of becoming centers of growth industries. In the future, educational institutions will be an increasingly important factor in determining where such industries locate.

In another decade, one can predict with confidence that if a state wishes to participate fully in the industrial expansion that is associated with such industries, it must have educational institutions with first-class graduate programs in engineering and science, and these must be adequate in quality and in number to correspond to the ambitions of the state. Likewise, if a community hopes to become a nationally important center for this attractive type of industry it must provide appropriate educational facilities. Finally, as the importance of the educational institution in relationship to growth industry becomes more generally recognized, competition for this type of industry between centers will hinge increasingly on the quality of the educational opportunities available.

In this there is a lesson for the State of New York and for this delightful community. New York has numerous fine educational institutions, but in proportion to the size of the state and its industrial base, the present educational activity at graduate level in the sciences and in engineering in New York is neither sufficient in magnitude nor adequate in quality to enable this great state to maintain a truly leading role in these industries of the future. Again, as applied to this community, the ceiling for its potential as a center for creative work, is going to be set more by the educational opportunities at graduate level that it can develop, than by the effectiveness with which the architects and urban planners do their work.

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## PROBLEMS OF PHYSICAL ENVIRONMENT

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Sticks and stones, glass and aluminum, stacks of wet chem labs, rows of shop modules - all tied together by a maze of wires, pipes and ducts with a conference room here and a cafeteria there - and we still have only a fraction of the total physical environment of a research and development center. Indeed, there are so many elements to be considered that probably the most useful contribution I can make is to offer a basis for the orderly consideration of all the elements, a framework, if you will, on which to hang all of the pertinent factors, tangible and some intangible (and yet physical) that constitute this physical environment. My point will be the necessity for thoroughness in the process of locating, planning and designing such centers and, as an obvious sequitur I trust, the necessity for thoroughness in the process of trying to create conditions in the State related to physical environment which will increase its resources and activities in the area of research and development. Thoroughness - so as not to miss some critical factor, but also to make sure that a solid effort is made to influence, improve or change every factor which may stand in the way of the creation of a successful center or of any center at all. Many factors which appear to be fixed may yield to careful analysis and imaginative action, by the planners or by management, or by the community or the State.

I will try to illustrate briefly such a framework or "matrix" pointing out factors that are frequently forgotten or that are assumed as inevitable problems not susceptible to modification, and some to which the group assembled here and later the State government as such

may want to address itself in order to modify or arrange the physical environment so as to make it more favorable for the location and expansion of research and development centers.

In our own attempt at thoroughness, in the sense of geographic coverage, the three discussants on this panel will discuss items of the "matrix" to the three broadly defined geographic types of physical environment found in New York State:

First, the unique environment of metropolitan New York City will be commented on by the Honorable James Felt, Chairman of the City Planning Commission of New York City.

Secondly, Mr. Thomas Linville, Manager of the Research Operation Department of the General Electric Company in Schenectady, and a member of the Advisory Council, will comment on the application of some of the factors discussed to the special problems of the other urban centers in the State, the special cases of towns with only one or two major industries, and the suburban areas which have become increasingly important environments for research organizations.

Thirdly, Dr. E. S. Howarth, Chief Engineer of the Alcoa Research Laboratories will cover everything that's left, that is the rural and more or less undeveloped areas throughout the State, based on his experience as Project Manager for the huge 2,300 acre technical center which Alcoa is developing in a semi-rural area near Pittsburgh. In this category would come the creation in a completely undeveloped natural environment of a developed, but still essentially rural environment such as the imaginative Sterling Forest development in which we are meeting.

I suggest that the myriad of factors involved fall into three broad categories:

The Natural Physical Environment.

The Man-Made Physical Environment.

And the Community-Made Physical Environment.

The components of each of these categories should in turn be considered in three dimensions: first at the scale of the Individual, then in terms of the Technical Center, as an entity itself, whether it be a single building or a complex of buildings, and finally in terms of the surrounding Community as an Extension of such a center.

The most expensive commodity in a research operation is the man or woman who will execute it. The creation of physical environment to attract the right man to do the job and to make his work productive and efficient is the very heart of the problem. Every industry considering the possibility of locating a research unit at a given site will have as its primary concern whether or not the physical environment can be modified or a new one created to which the right professionals and technicians can be attracted and where their work will be sufficiently productive and efficient to repay the investment required. And this is a very special productivity, that of the minds of men and women. While they must be given the proper tools and facilities (which is relatively easy), they must also be put in an atmosphere that will be conducive to concentration and creativity. That is why every factor of the physical environment should first be intensively analyzed in terms of the individual. This is doubly true when it is realized that in the life of the building being constructed it is possible that the only enduring element (other than the basic structure) is the men and women who work

there: their tools will change, the wires and pipes and ducts will be moved, rearranged and replaced to adjust to the ever-new tasks assigned, partitions will be shifted, air conditioning improved, and so on. The accelerating pace of research, the continual change (which is in the very nature of research), means that the only real constant is man himself. In industrial plants the structure can enclose the process, its machinery and services, with the flow of materials and products setting the plan and much of the physical environment. There the accommodation for the personnel involved, is in a sense, peripheral to that for the machine, and is becoming increasingly so as automation develops. In the research center virtually the reverse is true.

I stress this point since it is the adjustment of the physical environment as we find it in New York State to the requirements or desires of these individuals as individual men and women which will be critical to the success of your program.

Some of the most important factors of the natural environment are Climate, Topography, Landscape or Terrain, Water Supply and Drainage.

Climate is, to my mind, typical of the factors which have never received the thorough analysis which is required in terms of its possible modification to achieve conditions competitive with the reputed attraction of milder climes. In the Survey of Locational Factors Affecting the Satisfactory Operation of Industrial Research Laboratories in New York State, carried out last year by the Advisory Council, it is most interesting to note that while the factor of Weather had the fewest responses identifying it as "very important," it also had by far the fewest which said that weather of their present situation was "favorable," and one of the largest percentages of those saying it was "unfavorable." The

implication is that while not many are really happy about the weather in our State, not many feel that anything can be done about it anyway.

At present the typical architect and mechanical engineer called in to design a research building will assemble a smattering of vague data on temperature and humidity ranges (usually from local lore or possibly from readings at airports in quite different topographical situations); and so on to rainfall, snow and freezing conditions, numbers of foggy days, etc. Even when there is relatively good climatic data available for the region the application of it to a specific site is again done in only the crudest manner, largely intuitive.

"Let's locate on the south slope." The specific, individual climatic subtleties of any given site are rarely analyzed, largely because no simple technique has been spelled out - but also because our typical architect or engineer is not convinced that a detailed analysis will yield anything more valid than the approximate conclusions he can arrive at by observation and "experience." I submit that this lack of thoroughness may be one of the reasons that ideal physical environments have so rarely been created in our State where we must work harder to adjust to the somewhat more severe and certainly more varied climate than those of many other areas.

Actually the meteorologists and climatologists have information and technology which has been called to the service of architects and engineers only in the crudest ways. The interrelationship, insofar as human comfort and the design of buildings is concerned, between air temperature, humidity and pressure, solar radiation, wind direction and velocity, precipitation, topography, orientation, and local external modifiers such as tree cover, bodies of water, and other landscaping has

been analyzed and some technique developed by the Ogilgay brothers at Princeton and others, but this has not been converted yet into a simple handbook permitting easy interpolation from a mass of observations to a local situation. The Strain Chart developed by Professor Lee at Johns Hopkins and charting systems such as the Psychometric Chart used by Carrier could help us but still don't add factors of wind velocity and certainly are difficult to adjust to local factors of angle of incidence of the solar radiation, adsorption or reflectivity of surrounding landscape, etc. Local topography even of surrounding buildings can have appreciable effect on the specific climate immediately impinging on a specific building. Obviously, at present only an architect with a special talent for working with such charts plus great ability to fill in the gaps can or will apply them to his particular problem. If he did so he would then know what his specific local external problem was and how to improve it by proper location, orientation, and massing of the building.

But this is only one third of the story. The next question is the determination of the ideal interior climate desired for the individuals concerned. Again it is usual to make some crude assumptions of design factors for the mechanical engineers. Again we know there is a wealth of knowledge and technology which the physiologist has. It is all too often glossed over by the planners, largely because, again, there is no simple set of formulae, graphs or other mechanisms which would permit the planners to make thorough and precise analyses without taking time out of proportion to that available for the planning and design process.

Between the exterior conditions, and the desired interior comfort and efficiency zones lie the many modifiers which can convert the physical

environment as we find it to that which we should have. In this area also we have a wealth of knowledge which is only too rarely brought to bear. Manufacturer's literature gives us the U and K values of particular wall materials, and Bureau of Standards data and Professor Lee's work among others give us time-lag factors, and so on. But the data typically used by the architect is generalized and oversimplified, not permitting him to make a specific solution without a great deal more investigation and calculation than he may be equipped to carry out. And this is not only a matter of the detail of wall sections. There are numerous other modifiers which we are only beginning to employ in a precise way: various shading devices, double glazing and special glasses, reflective, adsorptive, and radiant surfaces, etc., etc., all of which, at present, need engineering analysis not typically available to the average architect in order to be precisely tailored to the specific building and individuals in it.

Beyond such analysis aimed directly at the individual in his work, analysis needs to be made of the center as a whole, in terms of the various groupings of the individuals, their movement around the center and the interrelationships between the buildings, their landscaping and special problems such as large paved parking areas. A thorough analysis can yield a much more effective use of siting and planning mechanisms to aid greatly in overcoming our climatic limitations. Again the average planner does not have available adequate, usable, detailed data and this might be made available to him through some form of State action insofar as it pertains to possible locations anywhere in New York State.

The same thing is true for the climate of the community of which the research center finds itself to be a part. In this case the community

planners have already developed considerable knowledge and techniques through which to gain as much benefit as possible from the climatic possibilities of a region or location and to offset the climatic liabilities; but the communities all too rarely avail themselves of this knowledge. It is suggested that this and many of the other factors affecting the community might be called to their attention by the State and know-how made available to them. A proposal that Governor Rockefeller made in his Annual Message this year for a new Executive Office of Urban Development, "to assist the Governor in urban and regional affairs in a manner comparable to that in which the Division of the Budget assists in fiscal affairs" can play a most important role in this respect. The Governor stated that "its objective would be to assist State Government in planning its varied programs for the conscious purpose of regional development in partnership with the municipal governments of the area and in cooperation with the Federal Government where appropriate." It would be obviously logical that research and development centers would be an important part of this. Not the least of the reasons is that such centers are a very important source of employment, which can, to a degree at least, be influenced to locate in relation to employment problem areas.

I have dwelt on this one factor because it is particularly pertinent to our State and because it is a clear example of how little we have done to attack the physical environment as we find it and create the one we want. The same type of analysis should be made in relation to topography, terrain, landscaping, water supply and drainage, and so on.

Those factors which I have grouped as the "man-made environment" are also not limited to the structures alone, nor even to the settings in which

they are placed. Roughly they can be grouped in categories such as structures, utilities, air, light, and sound conditioning, waste disposal and control, circulation, transportation, security, amenities, landscaping, color and texture, flexibility, and economy. Each should be looked at again in terms of the individual, the center or lab building itself, and then the community as an extension of the center. To take an example, the movement of the individuals who comprise the staff of a research center is a vital part of their environment. If the individual does not find adequate provision for access to the center and movement within it, his recruitment will be more difficult and when employed his work will be less valuable. Beyond the individual's comfort and convenience is the fact that in a research center, a very large portion of the ultimate "output" derives from the meeting together of groups of individuals to find solutions or plans for attacking common problems. In some organizations the joint activities of chemists, metallurgists, development engineers, and even sales development representatives underlies and sets the pattern for the work of the individual. Therefore, if the individual is inhibited from having direct contact with those with whom he should be working closely, a great deal of the investment made in bringing the individuals together is lost. Overly long corridors, unattractive tunnels, cumbersome shuttle systems, the necessity of putting on a coat and braving the wintry elements, or going out of an air conditioned building into a hot, sweaty summer atmosphere can reduce the intercommunication process, the generation of ideas through the meeting of minds and the efficiency of well-coordinated operations. Our urban concentrations have forced the development of highly efficient vertical movement of peoples. However, this vertical solution imposes

severe limitations on the flexibility, variety, and expansion possibilities of space arrangement which are so important to research and development units. Being forced, therefore, in most cases to consider horizontal solutions, the planner frequently finds that forecasts of growth and change are such that a compact scheme just cannot work, and distances begin to become so great that the men who should be able to work closely together just won't take the time or trouble. Solutions such as closed circuit TV will certainly be used more and more but some economical form of horizontal mechanical circulation should be developed.

This relates as well to one of the most difficult problems in planning the physical environment; the requirement for large, unattractive parking lots. And they are getting larger and larger. Much current planning is based on ratios as low as one parking space for every employee, professional or hourly. In some cases terracing and planting have served to break up or screen these areas, but the basic problem remains that they are either so close to the buildings that they ruin any chance of creating a pleasant setting for it, or they are so far away that, in the aggregate, much valuable time is lost and discomfort becomes serious. Here again, a simple, economic system of covered horizontal mechanical transportation could pick up personnel at central points in the parking spaces, not too distant from any car, and bring them to distribution points in the various buildings or connector points to an internal transportation system. Such a system would permit the placing of the lots at some distance from the buildings so that significant advantage could be taken of the topography to screen them and advantageous sites could be selected so that reduced costs of grading, paving and drainage might help offset the cost of the system. It might be noted that there

are many other instances where such a solution is necessary to the parking problem such as at air terminals, large shopping centers, sports facilities, etc.; and its application to choked downtown urban centers is obvious. All of these should be a sufficient market so that it seems inevitable that economical mechanisms will soon be available.

By the third category, "Community-Made Environment," I mean those factors which have been created by the outside groupings of society, whether it be governmental entities which have established master plans or zoning regulations or building codes, or whether it be a private real estate or commercial developments. The survey of locational factors made by the Advisory Council, referred to earlier, made very clear that suitable housing and good local schools are far and away the most important locational factors for such laboratories. While I may be encroaching on the "Social Environment" to be discussed this afternoon, I feel it is important to note that the physical location of housing and schools and their physical appearance and quality are of critical importance, as well as the social climate in the residential areas or the quality of education in the schools. This comes back to good town, city and regional planning, effective zoning, and building codes that will encourage good construction. Effective action at the State level in these regards should also result from the creation of the Office for Urban and Regional Development, of which I spoke earlier. More specifically, the interrelation between the housing programs in which the State participates, its relationship in local education, its own highway program and the Federal highway planning, its locating, planning and construction of recreational facilities, and the many related State activities can be brought to bear to establish and combine the elements of a desirable physical environment beyond the research

center itself. It is a matter of coordination and thoroughness, and the Governor and the Legislature are clearly taking steps in that direction.

Special attention must be called to the two distinct transportation requirements beyond the center or lab. The obvious one is for reasonably easy movement of personnel from house to work and back again. I need only refer to the heavy cost to any research organization of "down-time" in its operations due to its professional not being able to get to the lab or arriving late or leaving early because of bad weather, roads not cleared or sanded, traffic tie-ups, subway breakdowns, or even the New York Central being struck. These are all parts of the physical environment for which the research lab must depend on the community of which it is a part. This is clearly the area to which the State needs to direct its efforts. Of rather unique importance to a research organization is the second type of transportation requirement beyond the center or lab itself; ease of movement out from the immediate region to other centers of technical information, professional association, or company activity. This has come to be primarily a matter of travel by air, commercially or by company plane, or by car on the increasingly efficient interstate highway system. The greatest problem centers around the air terminals, and access to them.

This form of communication is so essential to most research and development units and time lost by top professionals so expensive that a specific review should be made of the accessibility of all the airports in the state and the worst situations corrected by State action wherever possible. Adequate access highways free of suburban traffic congestions are the most obvious solution. A much greater extension of

the use of helicopters may be found to be a much quicker and more economic-al solution for the particular need we have discussed, since it is not a large volume but one where time is critical. State assistance in providing downtown heliports and efficient regional helicopter service might be studied.

Thus we see again that thorough analysis of any one of the factors of physical environment, such as we have barely indicated for transportation, should be considered first in terms of the individual, then the lab or technical center as a whole, and finally in terms of the community as an extension of the center.

Now I may appear to have avoided discussing what comes first to your minds concerning the physical environment; the architectural appearance or arrangement of the buildings themselves. It is not a case of an architect tending to everyone else's business but his own. There is a tremendous amount of literature on how to arrange lab space, the relative economies of different utility stack arrangements, dozens of alternate solutions to the hooding problem, and so on. New solutions might interest you, such as interior labs backing onto walk-through utility cores, and so on, but you can all get these solutions from competent architects and engineers, and I do not see where the State can easily make a major contribution to such technical aspects. In any case it is not the core of the State's problem, which are the more peripheral factors too often neglected, such as climate conditioning, housing, schools, transportation, zoning, air pollution and noise control. Even with the new office of urban and regional planning it may be found that adequate tools are not at hand for the State's analysis of these broader problems. There is now within the State at present highly developed academic sources of assistance

specifically oriented to these problems comparable to the Joint Center for Urban Studies at M.I.T. and Harvard (to which the New York Regional Plan Association had to turn for its recent intensive reappraisal) or the Institute for Urban Studies at the University of Pennsylvania, although various schools of public administration and departments of city planning exist. To make available research grants to the faculties that do exist for the analysis and development of solutions to these problems, to prepare adequate planning guides, to spell out projects for State action and in other ways to bring professional knowledge to bear on the problem, might be a vital step forward, particularly if done in such a way that a more solid foundation of basic academic facilities in this field could be developed for continuing assistance to the State.

I will get back to my knitting with my final point. The physical environment created by the architectural appearance of the buildings, the landscaping, the color and texture of the facades and interiors, the spaces and proportions, the whole atmosphere and tone of the lab or center. Too many times in seeking technical solutions for the pipes and ducts the planners lose sight of the man who is to work there and the importance of the meetings of men which will take place. We are finally getting away from the prison-like piles of brick which meant "Research Lab" a few years ago and are remembering that man comes ahead of the machine, the human scale is more important than any module or structural system, and that it will be the very mood of the place that will best support the high degree of concentration and creativity vital to such centers. This will vary greatly according to the character or philosophy, if you will, of the company or other organization of which

the technical center or laboratory is a part. But within this wide range the requirements of providing pleasant surroundings for the individual and of providing flexibility for expansion and change appear to be producing a more human and intimate architecture, less mechanistic and cold, with considerable diversity within an overall unity. Certainly the importance of the setting is recognized more consistently than it was in the past. The Institute for Advanced Study is a somewhat rarified example but it is nice to recall that Dr. Oppenheimer says that more Nobel Prizes have come out of the woods that lie beyond the lawns around the Institute than from any other single spot in the world.

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## RESEARCH AND DEVELOPMENT

DR. JESS H. DAVIS

You are meeting here today to devote your attention to the implications of research and development upon the community and, conversely, of the community upon research and development. Your presence here attests to the fact that research and development is playing an ever-more-important role in the future, not only of New York State, but of the nation and the world. Your presence also leads me to believe that the research and development function has reached a stage of relative maturity - not maturity from the standpoint of lack in further growth, but maturity in the sense that its future contributions to mankind can be expected with increasing confidence. We have long ago passed the "trial" or "test" stage and have reached a point where the research and development people are actually the "fair-haired boys" in some organizations. I think this is as it should be. The fruits of research and development, new, or at least continually improved, products, services and production methods, are most important ingredients, perhaps even the most important ingredients, for the long-term success of either industry, operating under our "free-enterprise" system, or our very existence as a free nation.

I have used the term "research and development" with the intent to cover "basic or fundamental" research, "applied" research, and the development of products, services or systems. The dividing lines are not clear and distinct and the items not susceptible of sharp definition. One of my friends, working in the field of magneto-hydrodynamics, stated it this way, "If I am studying a hot plasma stream, this is basic research.

If I pass the stream through a magnetic field, this is applied research because I have a practical objective in the back of my mind. If I arrange the hot ionized gas and the magnetic field so that I expect to get some power out, then it's development." (I should state that this individual is what I would term a "purist.") I am sure that most of you do not agree with this example but I am equally sure that you would not all agree on any definition of research and development. However, it seems to me that the important point is to recognize the interdependence of the research and development functions. The results of so-called "basic research" are adopted, refined, and used in the development of new equipment or apparatus or products and services which often make possible more basic research, thus completing the cycle.

So if we consider research and development together, or as a unit activity, we find that in the last ten years expenditures have risen from about four billion dollars to well over twelve billion. Estimates for the present year, 1961, are fourteen billion. Ten billion of this fourteen billion will be used for work carried on by industry and financed almost 50% by industry itself. The remaining four billion will be expended in government laboratories and those of colleges, universities and other non-profit groups on about a 60-40 basis. Almost 60% of all research and development is supported by government. But there is more to these figures than their mere size. For while it seems likely that industry's support of research will substantially increase in the future - the extent of the support of Government will depend in no small measure on the needs of our defense effort and the progress, if any, of disarmament talks.

Many companies not yet conditioned to research will find they will have to engage in it if they are to meet their competition satisfactorily, and carry out their own policies of diversification. Indeed where figures have been made available, the facts indicate that the growth of companies both in sales and earnings is closely related to the percent of sales invested in research and development.

My friends in the investment community tell me that the stock of a company with a proven research reputation will often sell at a price computed at fifty or more times its earnings compared to fifteen or so for a straight manufacturing operation with little or no research activity.

Also it seems certain that in one sense, research will become more highly specialized. While paradoxically enough, these highly specialized activities at the same time will call for a combination of many different skills and types of researchers. More and more the electrical engineer calls upon the physicist, the mathematician, the chemist, for example, to aid in solving a particular challenge that once might have been in his own area alone.

Indeed, already most important discoveries are the results of team action, opposed to the lone genius of yesteryear working in an attic, subsisting on bread and water. Thomas Edison might be very hard put to produce inventions, today, working in the solitary trial and error way that he did in his lifetime. For now, groups of specialists from all fields pool their talents to come up with thousands of new products - a type of research that in turn produces entirely new industries.

This leads to the fact that research is becoming expensive, very expensive, and this is true for basic as well as applied work. In fact the finding of some new chemical elements, for instance, would not

have been possible were it not for the complex equipment, trained personnel and inspired leadership - all expensive items - which only one or so institutions possess.

I think all of us would like more financial support, from whatever legitimate source, for our research and development effort. The record shows, however, a dramatic series of achievements with the funds that have been available. So, if we can depend upon past experience, with more support, even greater progress toward sought-for objectives will be made.

This is not to say that those people responsible for our research and development programs can become complacent and devote their total attention to the problems of the moment.

There are a number of factors which, if not properly handled, can seriously affect the future of research and development.

Specifically - here are some reflections I would submit to you: There is a danger that research will be "oversold" to a general public that is woefully lacking in scientific, mathematical and engineering knowledge. I do not think we have gotten across to the general public the picture of research in proper proportion. They feel that research can do anything - that all you have to do is research something and the problem is solved. This, of course, is not true. Nobel Prize winner Polykarp Krush makes this statement:

"To assume science can find a technical solution to all problems is the road to disaster. For example, not all the power of science can in the long run feed an ever-expanding population. The assumption that it can do so is dangerous. Science in

itself is not the source of ethical standards, the moral insight, the wisdom that is needed to make value-judgments."

We must be very careful therefore in endeavoring to make the public at large research-conscious (so that the research needs of the country get full governmental, corporate, institutional and individual support); that research alone not be relied upon as the crutch upon which the country will lean as the universal panacea for all problems. We must also get across the fact that "time" cannot always be bought by dollars. Loss of faith through misunderstanding of research could have disastrous effects.

We have a serious problem in communications - communications, between scientist and scientist, engineer and scientist, and engineer and engineer. This is a difficult enough problem within one organization but it becomes overwhelming as we multiply the number of organizations and the people involved.

How does a researcher keep up with what his colleagues in his own field are doing - how does he familiarize himself with activities in other fields that might have some application to his own work?

How much useless duplication of effort and expense is there because we did not know the same work had been done or was being done elsewhere?

How many times could a development job have been done better if some newly discovered principle or concept had been known by the technologist?

True, where a field is young and there are not many people working in it, the possibility for communication between these people is excellent. But when a field becomes more established and more complex, and there are more people working in it, the number of publications that come out is

fantastic, and the possibilities of the right people meeting with each other at the right time become less and less.

The problem becomes even more acute because of the growing inter-discipline between the scientists, due to the tendency of the sciences now to blend at so many points into common fields.

Some important work has been done by industry, government and other groups in the field of information processing and retrieval, but with the literature in all fields increasing at such a rapid pace, much more money and effort must be expended if we are not to be seriously handicapped in all research and development in the future.

Another problem is what appears to me to be a lack of "professionalism" in some of today's research. At times this might almost be called "intellectual boon-doggling." It results from a number of causes; but the two most important are lack of professional researchers and lack of proper direction or leadership. It leads to a "sterility of discovery," a pedestrian "playing it safe," and the attempt to justify an appropriation rather than to risk a failure. But where there is no risk there can be no heights of achievement. In other words, we have here a type of policy-making that is most effective in hampering new developments - exploring only areas where it seems there will be an immediate payoff - administering the research function as if it were comparable to the more precise activities of an accounting department.

Research administrators must have the courage and foresight to invest in more ideas and areas that are not and cannot be specific - that may not - in fact will not - immediately, if at all, result in new products or services as such. They must, however, also have the capability in the form of a professional staff.

And this leads me to another most important problem, that of manpower with which to staff our research laboratories. There is already a scarcity of able people in almost every area and because of the increasing sophistication of research and development, many of the presently adequate participants will lose their effectiveness after a few years unless they have the inclination, the ability and the time to keep up with the demand, particularly at the doctoral level in the sciences and engineering, and in engineering at the bachelor's and master's levels. They need more funds, facilities and faculty to be able to handle more graduate students and to keep their educational programs "ahead of the time." They must turn out young men with doctorates who have been working at the frontiers of knowledge. To accomplish this they must have the most capable faculty, who are themselves working to extend knowledge, as well as the equipment and supporting personnel, that enable the job to be done.

There is now some cooperation between industrial research laboratories and graduate educational institutions but not enough. It would be to the advantage of both industry and education if a closer relationship could be worked out so that each could profit by what the other has to offer.

In this connection, as a college president, perhaps I would be remiss if I did not point out to my colleagues in industry and government where they might help to generate the excitement of our gifted young, upon whom so much in the future depends.

For, beyond providing physical facilities and educational opportunities on the college and post-graduate levels, there is especial need to reach our youth while still in the plastic high school period where the career and educational decisions are really made.

To set up, operate and maintain the complex equipment and instruments used in much of our research today we also need many more technicians - men trained in two year technical institutes - than are available today. New York State and a few others have recognized this need and set up institutions for such training, but there is still a lack of these important facilities on a national basis.

I think there is another serious problem to be faced in connection with the assignment of research, particularly that of a basic nature. Ideally, you do not assign this kind of work but you accomplish the same result when you support what the man is interested in exploring. I am seriously concerned about the frequency with which a young, apparently gifted and certainly inspired scientist perverts his ideas because he can not obtain support for his real interest. Although it cannot be proven, I am sure that much good work in fields that are not popular at the moment but which might contribute much for the future is lost in this manner. The National Science Foundation and a few other federal agencies attempt to support young scientists who wish to work in some of these less exotic areas but they do not have sufficient money to do the job on the scale that it should be done.

In the educational institutions, where the research is primarily of a basic nature, there is still too much of what has been called "projectivitis." Although I understand that all federal agencies are now empowered to make grants, much basic research is carried out through contract, rather than grant, support. This is perhaps because the research is closely related to specific objectives but nevertheless the contract is usually more restrictive than the grant and compels the researcher to particularize more closely. In turn this both uses more of

his time in the preparation of proposals and reports and also prevents him from exploring by-ways which sometimes prove more fruitful than the main path.

There may be no answer to this problem under the present circumstances but in the long-term, grants for the support of the man working in a given area will be more productive than contracts for work with a specific purpose in mind. These grants should also be for longer periods than is now customary because, in research, there must be wide latitude in time as well as scope, for the great creative achievements.

As an engineer, I am, of course, interested in the development aspects of research, the adaptation and use of basic knowledge in all fields for the use of man. Now where basic research has been part of a specific program, the time lag between discovery and use has been relatively short, but where it has not, there is generally a far greater lag. We could speed up our industrial and economic progress if this time lag could be cut. I think it can be done by systematic studies of basic research results for possible and feasible development applications. Such studies would have to be carried out by the most creative type of engineers and scientists. You might call this research on the findings of research.

Too often, the education of the engineer has not been of the type that provided him with the background necessary to understand either the many basic research findings or their significance. I believe this is now being remedied and I would hazard a guess that today, the graduating engineer from any first rate institution is better prepared than the engineer of twenty years ago with two years of graduate work.

As industrial research and development has grown and become an important force in our American economic patterns, it has brought with it a most serious situation for the small business. With some notable exceptions, the most effective industrial research is carried on by the larger corporations, those that are not seriously affected by having to wait, sometimes years, for a payoff, and who through their size are able to afford the capable staff and expensive facilities necessary to make their ventures a success.

But how about the small company? It simply cannot afford either the staff and facilities or the waiting. How does it come up with new or improved products or services so that it can be competitive in the long term? Perhaps through licensing or through farming out a part or all of their research and development to independent universities or research laboratories. But will any of this do the job? I am not at all sure that it will, but if something does not change the situation, eventually these small companies must either merge or go out of business. But before this happens, government will probably take a hand. It might be better to try to work out some other solution.

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## BUILDING COMMUNITIES FOR THE BUILDERS OF TOMORROW

DR. MARGARET MEAD

I have attempted to elaborate a model of an ideal community which would be built up specifically to accommodate a series of research institutions. Actually, as we have seen in the course of our discussions, this is most unlikely to occur. Instead, research institutions will have to be introduced into already existent communities. But a model, such as I have attempted to build, can be used as a way of evaluating real communities.

The United States is at a crossroads, where it is possible to choose between designing the communities of the next fifty years well or badly. Such an opportunity, let pass now, may not return again for many years. Within the complexity of problems of transportation, resolution of conflicting authorities, tax resources for new and growing areas, the question of the kind of community in which those on whom the burden of designing the future falls, is particularly important.

The segregation of those with special interests is an old tradition in this country; the community of religiously dedicated, the communities of artists - New Hope, Croton, Carmel, Woodstock - the communities in which the political Utopians have experimented. But the community of scientists and technicians specifically concerned with such problems as the development of atomic energy, the instrumental basis of automation, space, is new - only as old as Oak Ridge. These communities have been heavily influenced by the dictates of security and by the demands imposed by location, on the one hand, and by the desirability of such light, clean, high-level type industry, on the other. "New electronic industries" has

become almost a synonym for "desirable industrial expansion," with the undertone of worry over the dangers of atomic power, fall-out from the location of plants or bases up wind from urban centers. Association with defense has also created associations with military installations and the special types of isolation and integration peculiar to the military. The problems of public relations for the formation of these new communities are therefore very complex and affect, it must be remembered, not only the images of the scientist, the engineer, the machine, and the future of human beings, which are held by the surrounding communities, but also those who live in the new technological communities will reflect these views and come to think of themselves in many of the same ways. The image of the scientist and the engineer drawn by school children whose parents are semi-literate conforms in many respects to the image of the scientist presented in the house organs of great engineering firms, or in the advertising pages of SCIENCE. The feeling that scientific progress may endanger mankind, involve one in treason, destroy precious human relationships, produce unemployment and regimentation - these are all involved in the way in which groups of scientists and engineers and technicians live and relate to other groups in the community.

The special communities of the past - artistic and intellectual, religious and politically Utopian - all were related to the local ecology where they were located; artists and intellectuals have sought communities which were rural or devoted to special pursuits like fishing, and have maintained a relationship with the natives which was both close and explicitly different. Utopian communities have almost always included "dignified" manual labor, involving the care of plants and

animals. The new technical communities have no such immediate relationships with either the people or the natural life of a region where they work. The location is determined by the availability of power, necessary location, the presence of other industries and other installations of the same sort. The scientists and engineers are themselves a highly selected group who have developed their special interests in high school, often under counter pressures from family and school mates, who welcome isolation from other kinds of people and the relaxation of association with others who speak the same language and have the same impersonal unresponsiveness to other human beings. The demands they themselves will make on a community and the demands which, in their name and in the name of the state, the nation, and the world, the planners should make for them are often contrasting.

We may expect that the technical group will want good, modern housing, availability of the services which they recognize as essential, such as accessible airports, shopping centers, good schools, and some sort of rather loosely defined "recreation" for their families. The presence of others who are technically trained will be regarded as an advantage. Space to move around in, freedom from irksome interruptions due to faulty physical planning or tiresome social pressures, ability to get away when they want to - these they will recognize.

As designers, however, there are other needs which they will not recognize as readily but which are urgent if we are to prevent the further fragmentation of knowledge and the development of a technical elite totally out of touch with the humanities, with politics, with the ongoing life of the world. Because of their high intelligence and high technical competence, the other steps which must be taken on their

behalf must be very high level. Music is the art which is likely to appeal to them most, and locating a music center or an orchestra in such a community is one way of assuring both a fuller life for the technical group and also a diversified type of human community for themselves and the schools their children attend. Top technical groups usually contain a few foreigners, and this circumstance can be expanded into specific welcome to intellectual activities related to such institutions as the Columbia University Casa Italiana, International Institutes, the proposed "Welcome Corps," etc. The technical community should be explicitly keyed in to circuits of artistic and intellectual resources. There should be a theatre to which theatrical companies can come, a documentary film theatre, an art gallery for small circulating art collections, a first-class library able to tap both public and private libraries in the state, circulating collections of original paintings, records, tapes of all sorts. In the center of the community there should be these services which can tap the whole artistic and intellectual life of the nation -- efficiently and quickly and without requiring too much "do it yourself" of men who work long hours in laboratories.

The scientists and technicians associated with activities of this sort also need an outdoor life provided for them; if the natural world -- whether lake, or stream, or forest -- is at their door, they will make something of it, if not for themselves, then for their children. Community facilities, like swimming pools, shared by adjacent residents, provide for the kind of implicit democracy of the scientific world, if residential areas are also diversified. The sports they enjoy most tend to be sports associated with individual skills, and areas in which

their children can develop as swimmers, pole vaulters, runners, etc., are essential, as is provision for tennis, handball, etc.

All need for activities which involve bringing in groups of lower status labor, lower status employees, maintenance men, etc., should be avoided in favor of designing high level services and, if necessary, training programs for immigrants, which will involve the residence in the community of intelligent, but unskilled and possibly illiterate service people, whose children can benefit by the schools and provide some balance to the possible overintellectualization which will be encouraged in the homes of the technical community.

Among scientists and technicians we find a range from those whose primary scientific work is fed by vigorous and enthusiastic activity in many other fields - artistic, athletic, creative - and those who wish to pursue their special interests with absolute single-minded dedication and who regard all other types of activity - mowing the lawn, serving on a committee, going to a concert, or taking the children swimming, as an interruption. There will also be a certain number of married women who are also scientists and technicians and who will parallel this second group of men in their wish to be relieved from chores of the "do it yourself" variety. For the men who wish to work uninterruptedly, and the women who must carry the responsibilities of a career or job, and wifehood and motherhood, there is a great need for adequate community services which will relieve a certain section of the homes from domestic drudgery - nursery school, an organized source of high-level domestic help, gardening and grounds care, inexpensive food services, a 24-hour, 7-day a week repair service.

It is also a mistake to assume that because such communities consist of well-paid and highly trained individuals, there is no need for community social services, such as a mental health clinic, a small, well equipped community hospital, and generalized social work services to deal with the emergencies which will arise. A community is not a real community until people have been born there, married there, and buried there. Provision for birth, marriage, illness and death - within the community - is essential.

These communities must be open to the world to prevent the isolation, fragmentation, and specialization that will otherwise result. This means easy transportation, especially by air, as the ties of such men are wide and the spread of their special interests includes the whole country. But it should not only be easy to get away, it should also be easy for others to come, and there should be occasions for their coming. This requires the provision of comfortable and not too expensive motels and guest houses, where all sorts of guests - temporary consultants, interns, foreign visitors, etc. - can be put up. A conference center with the accommodations for at least 100 visitors is also recommended; this will bring groups to the community and favor the involvement of the technical community in nationwide activities.

There are other ways in which the diversification of the community at a high level can be attained; the location of colleges, special departments of universities, special research institutes which complement the principal technical interests represented. Recent developments in areas of California, where new electronic industries, special research institutes, and new branches of the University of California, are combined, provide a good model here.

Further diversification can be attained if provision can be made for weekend and vacation facilities for various types of specialists in the arts and sciences who will be attracted by the calibre of the services and the opportunities to associate with a lively intellectual community. Woods Hole has represented such an attraction. Lawyers, high-level civil servants, journalists, physicians, residents in nearby urban centers, would welcome such a spot. These facilities should be of varying economic levels, suitable for graduate students finishing their theses, and families with many children and a couple of pets who arrive in a battered station wagon, as well as more established and wealthy people.

Communications within the community are vitally important, so that notices of the arrival of interesting visitors, the visits of people in the community to other communities, lectures, film showings, special school activities like the National Science Talent Search and Science Fairs, special broadcasts and telecasts, will be brought to everyone's attention. Freedom to move from institution to institution as audience to special lectures or demonstrations is one of the ways in which such a community is welded together. A small daily bulletin, local radio, and possibly available closed television circuits, with provision for diffusion throughout several centers within the community, and to surrounding school auditoriums and places of assembly in other nearby centers, also makes the special technical community lively, self-activated, and a center of radiating intellectual and scientific interest.

Every imaginative effort put into planning such communities, and especially assuring the allocation of enough space for all of these activities, will pay off for the wider interests of the state in raising the level of education, the supply of future scientists, and in

assuring the type of installation which is valuable for the ongoing economic life of the state.

In recent considerations of the way in which cultural evolution takes place and the possibility of man's taking a more active part in directing the course of our own intellectual evolution, we have found it useful to think of evolution occurring where there were clusters of individuals who stimulate and complement each other's intellectual life. The surest way of developing such clusters is to have clusters of institutions which will attract research-minded individuals of many different kinds, and give them the environment in which their informal and voluntary interaction is provided for.

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## ECONOMIC PROBLEMS

DR. HENRY BUND

Before coming here, I had brought to my attention a definition of research parks as "an environment characterized by greenery, culture and scholarship." Since greenery has been adequately covered by Mr. Dudley's group, culture by Dr. Mead and her associates, scholarship by Dr. Terman's panel, there would seem to be little left for our economics team to discuss.

And yet, a great deal does remain to be covered. Despite the fact that many comments by the three other panels have clearly cut across economics, putting us in the last spot was a wise choice by those who did the programming. In some ways this gives us an opportunity to build on the impressive ground-work laid by the earlier panels. In addition, it presents us with the challenge to attempt to tie together, in part at least, several of the separate explorations in which we have participated throughout the day.

### Three basic assumptions

Before approaching the substance of our presentation, it should be useful to clarify certain basic assumptions from which we will be proceeding:

First, the earlier panels have already conveyed the variety of facilities and arrangements which can and must legitimately be considered under the heading of Research. We should like to re-emphasize that we too are not concerned with any one particular type of research. Meeting here at Sterling Forest, under conditions as close to pure as

can be found almost anywhere, we will of course be concerned with this type or grouping of research activities. But impressive as this development is, we must be just as ready to recognize that it represents the exception, rather than the rule; that far greater amounts of money, manpower and facilities are devoted to research activities in more prosaic environments, including especially the hundreds of separate laboratories and exploratory facilities maintained by corporations, as well as research centers maintained by educational and academic organizations of which Sterling Forest will have an outstanding representative when New York University has built its center here. For our purposes, it is the sum total of all these activities that is the center of our concern.

The second assumption from which we proceed is one which may seem to contradict the very title under which we are speaking. Along with the other panels we are to address ourselves to the "problems" - a word which conveys a somewhat negative tone. Far be it for us to deny, or even minimize the real problems and difficulties which exist in the relations between research facilities and the communities of which they are a part. And yet, we felt it was equally important to bring out the positive aspects in these relationships, to stress the gains which both can achieve. It seemed to us that the realization of the gains to be obtained, recognition of the mutuality of interests, may make an important contribution to the solution of those problems and difficulties which do present themselves whenever a research facility becomes an important part of a local community.

The third and final assumption concerns the goals or targets which we have set for ourselves. Certainly, a great deal has been said and written on the subject of this Symposium. In fact, one of the chief

difficulties encountered by our researchers in preparing background material for our panel was to sort out claims and counter-claims in a meaningful manner. But when all available data were brought together and reviewed, the one conclusion which stood out most clearly was that there was indeed a paucity of hard facts; that despite the abundance of views and judgements there were large areas in which no factual information existed to shed light on the relations between research facilities and the communities in which they are placed.

In the light of this finding, the economic panel decided to follow a dual course: (1) Bring out as many concrete, measurable facts as might be helpful in understanding the economic realities of these relationships, and (2) pinpoint those subject matters and questions where further investigation is urgently needed to provide a more factual basis for dealing with the problems of research and the community.

With that much of a preface, we should now be ready to move into the area of our preoccupation. Speaking from a predominantly economic point of view, there are two propositions which we should like to pose boldly at first, then support by such substantive proof as is available:

1. Having a research facility choose to locate or to remain within its boundaries offers a distinct and, to some extent at least, measurable advantages to a community.

2. In addition to the factors explored by the preceding three panels, there are specific economic considerations which will help or hinder the decision of a research facility to locate or remain in a particular location.

If both propositions can reasonably be substantiated, then it is our hope there should emerge from the discussion some concrete conclusions and recommendations of interest to industry, educational institutions, the state and its political subdivisions, down to the level of the local community.

### Economic Value of a Research Facility

Turning now to the first proposition, namely that there is a tangible value to a community in having a research facility located within its boundaries, a number of economic compulsives must be recognized.

The first of these is the steady push of industry into suburbia, exurbia, and beyond, which continues with an every accelerating speed. The other panels, especially those dealing with the physical environment and social problems, can undoubtedly support the proposition that the trend toward the outlying areas has in recent years, especially, become almost irresistible. It is now so strong as to have introduced a new word and concept, "intra-urbia," which represents the gradual merging of two large metropolitan centers and their outlying districts. We are currently in the process of witnessing this kind of development in the relatively short span separating New York City and Philadelphia. We are probably no more than a few years away from seeing the same process repeated over the longer distance between Boston and New York.

With the merging, or joining of the large urban centers, the choices available to the formerly residential communities located between them become drastically reduced. Where business is compelled to reach steadily further into formerly rural or residential areas, the individual community must find it less and less feasible to resist such "encroachment."

Thus self-interest and the pressure of social and especially economic considerations inexorably force a reconsideration of the reasons which ten or twenty years ago seemed to justify opposition to any kind of industrial facility. The fact that so many residential or rural communities have given up this resistance to industry within the last decade or so, is the most eloquent proof of the power of these forces. The conclusion which this trend urges upon us is that for the overwhelming majority of communities located within two-hundred miles or so of urban centers, the choice is no longer one of whether to admit industry, but that the only latitude realistically available to them, in fact the only latitude which they generally desire today, concerns the timing of the establishment of such facilities and the nature or character of the facilities to be located in their area.

The second major compulsive which forces the geographic expansion of research facilities into new areas stems from the mounting financial pressures under which most communities find themselves today - pressures which could be offset or at least eased by retaining or bringing into the area industrial or commercial facilities. For the moment, it will be helpful if we ignore the unique features of a research facility and address ourselves to the advantages inherent in any kind of an industrial operation.

Probably the easiest way to drive home this point would be to emphasize the problems encountered by suburban communities which have successfully resisted the introduction of any kind of commercial facility. By and large these are the communities which have the most violent conflicts over local taxes, which have found their residents in the most

serious predicament of having to choose between inadequate school and other public facilities and prohibitive local taxes. What once was considered a very desirable role - to serve as the "bedroom" for an urban center - has rather suddenly become the curse of the communities which find themselves saddled with the cost of furnishing community facilities for the families of the "men who simply slept there."

This indeed is the heart of the growing conflict in so many suburban communities where local school taxes, pushed way beyond the limit by the absence of any but individual taxpayers, have finally caused a revolt by the very people who stand to benefit most from a particular school program. It is at the center of the conflict which we can see mirrored, not only in New York State, but throughout the country in the disagreement between local residents and the people they helped elect to public office - the only difference between them being that the elected officials usually are more apt to recognize the inescapable necessity to impose higher taxes on their own supporters, unless some commercial or industrial facility can be brought into the community to help defray part of the inevitable cost of what the electorate and our rising ambitions demand.

But yielding to these unrelenting pressures would represent a purely defensive posture. None of us would be naive enough to ignore the fact that in some instances it was such solely negative motivation which induced individual communities to accept industrial facilities - with the almost predictable result that this negative spirit adversely affected the attitudes on both sides, introducing a great many more complications in the initial adjustment between the facility and the

community and making the solution of every one of the problems which were bound to come up that much more difficult.

Fortunately there are also some very specific, positive reasons why a community of the type we have been discussing should welcome an industrial facility within its borders; why such a community can maximize the positive benefits to its residents by taking the initiative and inviting in the type of facility which will afford the greatest advantages and a minimum of drawbacks.

#### Specific economic benefits

The first tangible advantage which readily comes to mind, rather unfortunately, it should be added, is represented by the amount of tax dollars which such a facility is bound to produce. No one should try to minimize this direct contribution which plants and other facilities are making to the communities of which they are a part. Regardless of which side one chooses in the controversy over federal aid to education we must agree that the clamor for federal assistance would have come much earlier and would be far louder were it not for the dollars which industrial facilities have contributed as taxpayers in local school districts. Nor are schools the only beneficiary of such taxation.

With the general clamor over the federal tax load which purely by coincidence happens to be particularly loud right now, just two weeks after the painful April 15 deadline, the general public and many of the men responsible for guiding community affairs are not nearly as well informed or vocal on the rate at which state and local government spending has been cutting into everyone's pocketbook. Without badgering you with statistics which at best are hard to read and even more difficult

to absorb by ear, let me just point out that between the years 1952 and 1959, federal expenditures had risen from 65.4 to 80.7 billion dollars or less than 25%, but that during the same period, state and local spending has gone up from 30.9 to 58.6 billion dollars or a full 90%. During the same interval federal expenditures showed at least one dip, short lived though it was, but state and local spending has continued in an uninterrupted up-trend. Finally, while there are some disagreements among economists on how much federal expenditures will have to rise in the coming decade, while there are some experts who believe that the federal government will actually take a smaller percentage of our gross national product than it does just now, there is practically unanimous agreement that state and local spending will continue to mount for the next decade and probably beyond. With this kind of a continuous and growing drain few communities will be able to afford the luxury of doing without the substantial tax contribution which an industrial facility can and must provide.

But having acknowledged the first thought which comes to mind in connection with an industrial facility, it should be added immediately that, in most cases, this is not even the most important benefit to be derived from having a facility within the community's boundaries. The key to assessing these added economic advantages lies, of course, in the one element which constitutes the heart of our economic system, no matter how high the degree of mechanization or automation we reach - the people involved. Having any facilities located in the particular area means that X families will be moving into the particular community or those surrounding it; it means that Y different job opportunities will open up to those who now live in the particular community; and it

means that Z individuals will be required to visit on a more or less regular schedule the particular plant or facility.

Translating this XYZ into specific economic terms is far more complex than may seem on the surface, but some informed guesses can be made as to the size of the economic impact created. First, and without necessarily endorsing every last comma and percentile, let us turn to the specific estimates arrived at by the U.S. Chamber of Commerce in a fairly recent survey of the economic impact created by new industrial facilities. Anxious to go beyond the usual platitudes about an "added payroll," the Chamber's economic research department studied nine counties in which a significant number of new industrial jobs were created between 1940 and 1950. Even recognizing the obvious fact that this particular decade saw one of the sharpest increases in the U.S. price level, both at wholesale and at retail, the following findings nevertheless merit the attention of any group concerned with the economic effect which an industrial facility has on its host community.

For every one hundred additional employees added to the manufacturing payrolls by the process of such industrial expansion, roughly three additional people were added to the local population. More importantly, the number of employed persons increased by 174 to every 100 additional manufacturing employees; or to put it another way, roughly three additional jobs were created for every four employment opportunities opened by the new manufacturing facility. In terms of the then more valuable dollar, personal income increased by \$5,900 for every additional manufacturing employee. Significant to the financial community, bank deposits increased by \$2,700 for each employee, or

roughly half the average income of these new jobs - a ratio which is likely to have been maintained throughout the inflation of the nineteen fifties.

Possibly the single most impressive indicator of the economic gains resulting from the creation of such new employment opportunity comes in the form of added retail sales. Each of the additional manufacturing employees who joined the work force of the nine counties studied by the Chamber was responsible for a net increase in retail sales of \$3,600. Of that total, grocery stores showed the single most significant gain - \$700 per year. Next came automobile dealers - \$500, department, dry goods and variety stores - \$450, and so on down the line. It is easy, of course, to discount these figures by emphasizing the effects of inflation, which would have boosted retail volume in any case. But even after such discounting, the fact remains that there has been a very substantial increase in the rate of business activity other than the one directly responsible for the added employment. In other words, the community at large benefited to a very substantial degree, both directly and indirectly, from the additional employment opportunities created within its borders.

There are many additional yardsticks which, to the best of our knowledge neither the Chamber study nor any similar survey has ever adequately explored. However, one simple conclusion is both easily probable and deserving of emphasis: If that much of an economic impact is demonstrably created by the addition of routine manufacturing jobs, the benefits accruing to the community from a research facility with its higher income level personnel must be that much more potent. Fortunately enough, we do have some rough indications at least of the relative

income levels of the two groups. A Bureau of Labor Statistics study in early 1960 pinpointed the pay range of engineers as between \$6,400 and \$14,000, that of chemists between \$5,500 and \$13,700, that of mathematicians between \$5,800 and \$15,000. These earning levels compared with an average annual income of the industrial worker, on which the Chamber study was based, of approximately \$4,500 (At the terminal point of the Chamber study, this figure was about \$3,100). What this difference in income levels means in terms of the immediate impact on retail stores can be shown by a few simple comparisons:

For example, food, beverage and tobacco purchases for the average household in the \$4,500 group come to just under \$1,300 per year, those earning \$10,000 or more spend \$1,900 or 50% more. And this is actually the least impressive of several possible comparisons. Personnel most likely to be employed in research facilities spend nearly twice as much as the average manufacturing worker on medical and personal care, more than twice as much on so-called discretionary spending, which is the real driving force behind our standard of living and which includes such elements as medical and personal care, home furnishings, clothing and recreation. In other words, even before concrete factual data are collected the general statistical information available today proves beyond doubt that the indirect economic benefits accruing to a community from the employment of a research facility in terms of added payrolls and retail trade are certain to be both sizeable and substantially greater than those obtainable from any general industrial facility. But even that is only the beginning.

It is unfortunate indeed that the moment we move beyond these first measurable effects of new employment on retail trade, estimates of the

economic impact become more elusive. Those in the audience who have had experience with commercial market research will realize, of course, that the higher income levels of personnel customarily employed in a research facility will of themselves produce certain predictable economic benefits, such as homes in a higher price class, built on larger parcels of land, more carefully and expensively landscaped, than would be true in a lower income settlement. Our sociological panel has already brought out certain other benefits which in economic terms accrue to the community, such as the more active interest and participation in community affairs by professional personnel usually employed in research facilities, or the encouragement and support given to a variety of cultural and intellectual endeavors which make an identifiable contribution to the total attractiveness or value of a given community.

These illustrations could be continued for some time. Still, I'd have to be aware of the fact that I am speaking about matters which simply defy precise statistical measurement. There are few who would disagree with the basic conclusions; there are fewer still foolhardy enough to be willing to stick their necks out in terms of guessing their precise effect in dollars and cents. But there are two more areas in which factual proof is somewhat easier to come by.

The first of these is the uneven rate of economic growth. With the current propensity of the American people to play the stock market, most people are thoroughly familiar with the word and concept of growth industries. The record is incontrovertible that in the recent past these were the activities and companies which have led the expansion of the total economy. Indications are equally clear that in the coming years as well, they will again be in the forefront of economic growth.

With few exceptions, these are the very lines which most extensively rely on research and development. Once a community has decided to accept an industrial facility within its borders, it would seem to be no more than prudent judgement to try to attract those industries and facilities which harbor the best promise of future growth and expansion. In practical terms this means concentrating on industries with substantial research expenditures and facilities.

Then there is still another demonstrable economic plus. No research facility exists in a vacuum; its mission is to serve the needs of a larger organization, the ultimate purpose of which is production of tangible goods. While considerable disagreement continues to exist within industry on whether laboratories and other research installations should exist close to or far apart from production plants and corporate headquarters, it is quite obvious that few research facilities can exist without the availability of plants and equipment suitable for experimentation, able to project research findings into the pilot stage of operations at least, serving as a realistic laboratory for the ideas and concepts dreamed up in the solitude of the research bailiwick, and model-making as well as similar "service establishments."

While no statistically adequate figures have been compiled to measure the total of these secondary effects of a research facility, they can be demonstrated from individual case histories. By a fortuitous coincidence, only two days separate us from the official dedication of Republic Aviation's spanking new Paul Moore Research and Development Center in Farmingdale, Long Island. Whether or not the company is correct in its claim that this represents "the finest and most diversified privately financed laboratory of its kind," definite economic results are

beyond dispute: the new Center will mean the addition of roughly 200 engineers and scientists, almost doubling the number employed. Because Republic found it desirable to locate this Center at the site of its main production plant, direct benefits will accrue to the local community of Farmingdale, to the dual counties of Nassau and Suffolk and to the state as a whole. One measure of these indirect benefits is the fact that in the last year alone more than \$26,000,000 worth of business was placed with roughly 4,000 firms in New York State. With the company's preference for local and for small business, 879 of these sub-contractors were located on Long Island; possibly even more important 820 were in the small business category, providing the kind of stimulant that is urgently needed to perpetuate independent small business which has been so essential to much of New York State and the country at large. The opening of the new Center should, of course, increase these figures.

By now, the economic values inherent in having a research facility located within a particular community should be self-evident. In fact, reviewing the arguments just advanced might make me feel like a press agent acting on behalf of such organizations. But if the advantages were as self-evident as all that, none of this presentation would have been necessary. If the arguments were all that one-sided, then our panel's entire job should now be concluded. Unfortunately, it cannot be.

#### Economic Drawbacks

As a resident of suburban communities for several decades, I can truthfully say that, along with my neighbors, I became aware of the disadvantages a long time before anyone had the perspicacity to call to my attention the positive benefits which we as a community would derive from

having an industrial facility located in our area. The unpleasant reality is that for every one of the economic benefits just cited there is a parallel disadvantage; that no community can hope to reap benefits without paying a very distinct price for what it has gained.

Paradoxically the only communities which will not be concerned about the price which must be paid are the very ones where a research facility is least likely to locate or to remain. Conversely, the drawbacks will probably weigh most heavily on those communities which, by most of the established tests, will be considered particularly desirable locations.

If I seem to approach this second major topic with some hesitation, this is not based on any reluctance to bring out the negative. Being a suburbanite myself, I am fully aware of the fact that most of you have had enough first-hand experience of these disadvantages to have them treated glibly or lightly. Nor do I believe that anybody would be doing industry generally or research facilities in particular any favor by attempting to hide or obscure the obvious drawbacks which they bring; on the contrary, some of the heartaches, bitterness and disappointments could probably have been avoided had there been a clearer understanding on both sides of the disadvantages which almost inevitably accrue.

My reluctance is entirely based on a professional economist's natural hesitation to engage in generalizations which he is not prepared to back with specific facts and figures. If the benefits which a research facility brings to its host community at times have proved difficult to measure, the economic disadvantages have been fathomed even less. This despite the fact that at least some of the drawbacks are both tangible and should, therefore, be measurable. (At this point it should be suggested parenthetically that for this very reason

these disadvantages should represent a fruitful area for specific research which could pay off in a more constructive attitude on the part of both the community and the research facility.)

Even selecting the point at which to start the listing of disadvantages definite problems are encountered. Take the very existence of a research facility which if it consists of more than simple offices and encompasses some laboratories will tend to fall into the "Industrial" category. Most residential communities - North, South, East and West - have been resisting industry for so long that the mere mention of the word arouses opposition and visions of traffic bottlenecked by trucks and rush hour movement, lowered property values, a deteriorating neighborhood, "undesirable" new elements moving into the community, etc. The fact that most communities have long ago learned to protect themselves against many, if not all of these drawbacks hasn't fundamentally altered this traditional attitude. The first industry, no matter how innocuous and fenced in - both literally and figuratively - still must bear the brunt of the community's resentments and suspicions.

Against this background what then are some of the tangible reservations which community spokesmen voice against any kind of industrial facility - and how do they apply to research facilities in particular? Without following any necessary order of priority or frequency of mention, let me list those which have come up repeatedly:

The sheer physical presence of an industrial facility of any kind tends to upset local residents. Regardless of their own personal preference, they can cite concrete figures to "prove" that in other communities the homes immediately adjoining a property newly zoned, even for light industry, have gone down in value. The only thing unnatural

under these circumstances would be the absence of opposition. No argument, regardless of how logical, can overcome this fundamental objection. It is true, of course, that communities have grown very wise in exercising their zoning privilege; that communities first opening their doors to industry are particularly careful about specifying the minimum land use ratios required of new tenants; that everything down to the final design of the proposed structures is subject to the approval of the city or village fathers. The psychological impact of the word "industry" is enough to send the blood pressure of the neighborhood home owner up, and in his own estimate at least, the value of his home down.

It doesn't really matter that these fears have in most cases proved exaggerated or even totally unfounded. It makes a slight difference at best that the current trend in industry is toward planning for future expansion, which means pre-empting enough open land to permit considerable additions to present structures without infringing on, or violating existing zone rules. It doesn't even matter that research facilities especially can and are being built increasingly to esthetically satisfying designs (according to one story which I personally would hope was apocryphal, a company - about to spend better than \$30 per square foot on a new laboratory - gave up trying to cut the cost of a "plush" exterior when it was told that the cost of the building would be reduced by only 35¢ per square foot if it had no outer walls at all). Surrounded as we are here by extremely attractive buildings housing research facilities, and realizing that even where laboratories or workshops have taken over dilapidated old garages, they have somehow managed to improve their appearance, we should be willing to accept the fact that depreciation of home values is not permanent - and yet be willing

to concede that temporarily at least, there can indeed be a downward push on real estate values when a non-residential facility for the first time invaded a formerly residential community.

But these initial fears are only the first of a series of problems bound to arise. There are much more specific complaints bound to be voiced against any industrial facility, including one devoted to research. While they may be less virulent in the latter case they exist, nevertheless: smoke, odor, noise, even vibrations can present a genuine problem expressed in a lowering of the economic values of the surrounding property. Having been at both ends of bitter disputes on these problems, I can assure you that no amount of factual data can completely overcome the fears and suspicions in these respects. Even after all of the known objections have been dealt with and adequate safeguards provided, the fact remains that a residential community will forever remain fearful of how the changing character of the operation they are permitting to come into their midst will in the future affect them physically as well as economically.

The third major economic objection, raised even against research or other light industrial facilities, stems from the sheer necessity to provide additional services. Utilities represent the relatively least important element since they are largely paid for on a use basis. More important, especially in the case of laboratories and other research installations, is the necessity to provide for substantially increased use of water and additional problems created for sewage disposal; while a community may protect itself against excessive cost on the latter by requiring special handling of waste materials, the net effect of too many new facilities has nevertheless been to add substantially to the

community's cost of providing sewerage. Still along the same lines, the presence of a research or other like industrial facility will almost invariably necessitate additional police and fire protection which, no matter how generous the contribution of the company, will inevitably show up in the community's budget sheets.

This brings us to the next economic factor to be considered in evaluating the cost to the community of having research facility located within its borders. Invariably, new residents demand new facilities. The higher the cultural, social and income level of the new arrivals, the greater are these demands. In considering personnel employed in research facilities, it is quite obvious that most communities must anticipate a more than proportionate step-up in requirements in everything from schools to recreational areas, hospitals to shopping facilities, churches to public health and welfare activities. Admittedly the presence of a research establishment and the arrival of personnel to be employed there will considerably broaden the tax base from which to finance such facilities. Admittedly, too, an industrial as opposed to a residential property is likely to be a more ready target for serious taxation. Yet it would be less than honest to ignore the fact that in quite a few communities the question is currently being asked whether the additional cost of providing the services required by the new facility and its employees does not in fact exceed the additional revenue which they helped to bring in.

And this question quite logically brings us back to the consideration mentioned earlier in this presentation, that is the role of the industrial facility as a taxpayer. Speaking in a state which is the heart of so many large corporations, which is the center of so many

separate industries, it might be more politic to ignore the manifold inducements offered by other states in an effort to attract new industrial, as well as research facilities. It might be polite to ignore the fact that some facilities have indeed been lured away by the promise of special concessions, including outright exemption from local taxes for a specified number of years. No matter how great these inducements, no objective advisor would ever conscientiously council any company to make a long term committment based on such relatively short range promises. No industrial facility can hope to exist in a community for any length of time without paying its share of the cost of maintaining the facilities which make the community what it is. This statement is especially true of a research organization with its high caliber, high income and more demanding personnel.

Which way the scales finally balance out, whether the additional facilities required will cost more or whether the plus value generated will amount to a great sum, when a research facility is located in a given community remains an open question. There are, of course, some early indications. For example, a study completed about four years ago by Hofstra College appeared to prove that in Nassau County during 1955-56 revenues from residential properties covered only 83% of costs for public services given to home owners, while taxes from industry exceeded by nearly 173% the cost of services rendered to them. Even more disturbing are surveys such as the one conducted by Harvard University, with assistance from the Federal Reserve Bank of Boston and the Greater Boston Economic Study Committee, which showed the rising role played by tax considerations in deciding plant location: 30% indicated that local taxes would be a factor in their future

decisions, 49% were so concerned with State taxes. In part at least, prompted by these scattered bits of evidence I would respectfully urge that some early research shed light on this important question and provide concrete guide lines by which economists can begin to measure the net impact in terms of taxes.

However, I hope you will share my distrust at finding in as highly respected a publication as the Harvard Business Review a reference to a New England town where "a gravel pit which had brought \$3,320 per year in taxes has been developed into an industrial park yielding \$325,000." Any community which sets out with the objective of duplicating this feat or of developing a never ending source of plenty is bound to get hurt - as will any industrial or research facility which falls into its trap. There must be a mutuality of interests which will keep both the community and its research tenants interested in maintaining relations which both will find to their long term advantage. Rather than side with the example of the gravel pit just quoted, I would hope that this Symposium can move ahead on the closing note sounded in the letter from a friend of mine, Robert Rod, the president of Acoustica Associates, a company which for objective reasons beyond their control moved the bulk of their operations from New York to the West Coast last fall: "To isolate one community against another and legislate to the advantage of either is, in my opinion, undesirable. From time to time, the concentration of technical effort, particularly in electronics, seems to shift from New York to California, to Route 128. I think this is good and shows that technological progress is not the sole attribute of one geographical area. There may be a time in the near future when Acoustica may feel it necessary to expand again back

East. If this comes to pass, I hope we can do so without being hindered or hampered in any way."

Let us hope that New York State, with its unequalled representation of industry, corporate headquarters, educational and scientific establishments, cultural and communal advantages, can do better than merely hold its own in such a fair competitive race for tomorrow's growth companies and their research affiliates.

Henry Bund, LL.B.; Ph.D.  
Senior Vice President  
Research Institute of America  
New York, N. Y.

## SUMMARY AND CONCLUSIONS

DR. AUGUSTUS B. KINZEL

An important part of the Symposium were the discussion sessions held on the day following the formal presentation of the various keynote speakers. The separate discussions of the individual Panels were followed by a discussion session of the members of all of the Panels meeting as a single group. In the individual discussion sessions the basic premises were established and set forth in detail and specific recommendations were suggested. The premises and conclusions of the individual Panels are set forth in detail in the Appendix that follows. Each of these conclusions has been referred to the appropriate officials of the State Government for consideration and action. It is suggested that those interested in the reasoning and the detail in any particular area read the appropriate section of the Appendix. The following is intended to give the highlights of the premises and recommendations as a whole.

Because the number of students in graduate and undergraduate work will probably double in every decade in the foreseeable future, it is a matter of prime importance that the relation of advanced education to research be generally understood and that the importance of industrial research in the total picture be recognized. Moreover, the relation of national and state projects must also be understood. At the present time, coordination in the planning of these activities at the Federal, State and local level is inadequate. Substantial improvement is essential.

With respect to so-called "Research Communities," it is important that the community be balanced in all respects, with allowance for mutual interaction between its various elements. Isolated provincial groups of specialists working for a single employer or engaged in a single activity do not make for a healthy, balanced community. The necessity for planning is obvious and any group, be it a corporation, county, state or country, that fails to try to do the best planning with respect to community environment will fail of its goal.

Based on these premises, supplemented by others set forth in the Appendix, a series of recommendations were developed. Among these are a few worthy of special mention.

First, and foremost, it is recommended that a New York State Science and Engineering Foundation be established to aid in the educational facilities problem, educational programs problem, student support problem, and particularly to provide increased opportunity for graduate study. This recommendation is being seriously considered by the Governor and his advisors.

Another recommendation is to the effect that a planning booklet be prepared under the auspices of the State specifically directed to the problems connected with the establishment and planning of research and development facilities in New York State. This should deal with the coordination of local and State planning groups.

With respect to education, there is a strong recommendation that the State Department of Education and the Board of Regents encourage the development of strong centers of urban studies. These could comprise new academic facilities or be developed from existing facilities, depending on the situation.

Finally, it is recommended that regional conferences be set up by the Government of the State of New York, that leadership adequate to planning the solution of specific local problems be made available by the State and that these regional conferences concentrate on the impact on a community of the establishment of a research institution in its area.

In any symposium of the kind here reported, one should ask the question whether or not a purpose has been served. It is evident from the foregoing that this conference has served a useful purpose and that as a result, the approach to research and education and their relationship in New York State communities is better understood. Further, this understanding, enhanced by subsequent study, will be communicated to those who, in the last analysis, must deal with the local problems.

Augustus B. Kinzel  
Vice Chairman  
New York State Advisory Council  
for the Advancement of Industrial  
Research and Development



## APPENDIX

Reports of the Individual Panels to the  
Joint Session of all Panel Discussants  
at the  
Symposium on Research and the Community

### PANEL I

#### HIGHER EDUCATION AND TRAINING

Dr. John R. Dunning, Chairman

Basic Premises were stated as:

1. Research is a major factor in our increasingly technological economy, with education, in its broadest sense, at the base of our considerations.
2. The pattern of industrial development throughout the United States has many different facets, going from the older and more basic production industries to the "growth" industries, which are characterized by a high degree of advanced research concepts.
3. Our educational growth is geared to advanced education and research, with an increasing need for better-trained scientists and engineers in universities and industry.
4. Institutions of higher learning and industry share a real responsibility with respect to advanced education and research that should be looked upon as an opportunity for splendid future development.
5. If we are to realize our potentials for the kind of future we believe our society and economy should have, we must lay the foundations by effective and properly-supported long-range planning now.

## Recommendations

Preface: The President's Science Advisory Board issued the Seborg Report several months ago. This report has forecast the educational and research picture in the university framework, with proper correlation to industry, over the next decades. It considers that the number of students on the bachelor's, master's, and doctorate levels will probably double every decade in the foreseeable future. Of primary importance today, however, is advanced education and research as it relates to the industrial research and development situation nationally and to New York State, in particular.

New York State has had a solid past in its economic and educational development, yet there are many who feel that we are now lagging behind or failing to take full advantage of the potentials that exist in the New York area. In view of this, a new approach to the advanced education and research problems of New York State seemed necessary, and it was strongly recommended:

1. That a New York State Sciences and Engineering Foundation be established, to include the following goals:
  - a. Solution of the educational facilities problem;
  - b. Solution of the educational programs problem;
  - c. Support of students seeking advanced education at the master's and doctorate levels; and
  - d. Emphasis on increasing fulltime graduate study opportunities

Such a foundation can be successful in the advanced education and research area only if it is of the highest order of competency, if it has a broad outlook of the total New York State problem, and is not focussed toward specific institutions, regions, or industries.

The administration of the foundation should be conducted by engineers and scientists of high professional reputation and integrity, including representatives from industry and universities.

It is recognized that the greater portion of the foundation's funds would have to be provided by the State through legislation; to some extent supplemented by Federal and institutional funds. However, the foundation should be able to accept private funds from industry and other sources as a matter of principle.

2. That the Advisory Council and the Board of Regents study the problem of lack of effective advanced education and research programs in the rural and quasi-rural areas throughout the State.
3. That the Commissioner of Commerce discuss the New York State income tax in relation to its effect on attracting top quality professional people to New York's universities and industries; that he also discuss the Federal income tax policy, particularly as it relates to income tax free status for students.

## PANEL II

### PHYSICAL ENVIRONMENT

Mr. Thomas M. Linville, Chairman

#### Basic Premises emphasized were:

1. Thoroughness is necessary in considering all the factors of the natural, the man-made, the community-made environment in the process of locating, siting, planning, and designing of research and development facilities, based on full consideration of the individuals concerned, the center as a whole, and the community as an extension of the center. Competent architects and planners should be fully utilized in this process.
2. Coordination of the planning and related activities at the Federal, State and local levels is presently inadequate and must be substantially improved.
3. Metropolitan, urban, suburban and rural problems are interlocking, and all are essentially urban in terms of facilities and services required in the acquisition of adequate sites, etc.
4. There is an inadequate supply of fully-trained planning personnel, academic resources at sufficiently high levels, and basic planning data.

#### Recommendations:

The panel recognized that, while the following were not completely independent of New York State problems, they were offered as recommendations particularly of national interest and impact:

It was recommended:

1. The coordination of Federal, State, and local programs is imperative. This may be substantially improved by the establishment of the proposed Federal Department of Urban Affairs.
2. That extension of Title I procedures and related Federal programs to apply more directly, particularly in relation to site acquisition for research and development facilities, should be encouraged.
3. That, in view of the inadequacy of complete basic planning data aimed directly at such research facilities, a planning booklet be prepared under the auspices of the State, and contain specific reference to the establishment and planning of such facilities in New York State. Such a handbook, in addition to improving the planning within the State, would have an impact nationally through its distribution to the industrial community and planners and architects nationally.

#### New York State

It was recommended:

1. That the Symposium applaud the Governor's action towards establishing an executive office for urban and regional planning and development. This office can be a major instrumentality for the coordination of planning and action to establish the complex physical environment in its broadest sense, including housing, schools, zoning, etc., which is basic to the development of research facilities.
2. (a) That action be taken through the growing number of county planning boards and local development authorities;  
  
(b) That the proposed Job Development Authority be fully supported and when established, be urged to include research facilities as one of the important elements in its program. It is understood that the use of condemnation is one of the Authority's powers and is most important to the establishment of well-located research facilities.  
  
(c) That each local development authority be urged to include as one of its directors the representative of any local university or college and a trained planner or architect.

3. That the State should study its participation in the urban renewal program and its activities in relation to local zoning and building codes, and in relation to assisting in the establishment or expansion of research facilities.
4. That, in view of the lack of fully developed academic resources in the area of urban studies at the graduate level, the State Department of Education and the Board of Regents encourage the development of one or more strong centers of urban studies, possibly based on the existing nuclei of such academic facilities.
5. That it is urged there be developed much closer relations between educational institutions, state agencies, and local governments in these areas.
6. That local transportation is of particular importance in relation to the short haul feeder air lines, and that the State should encourage all possible local commercial service and local airports.

### PANEL III

#### SOCIAL PROBLEMS

Dr. Richard G. Folsom, Chairman

#### Basic Premises were stated as:

1. Attention should be called to the fact that, in the American economy, growth is a necessary component for the well being of a community and that research contributions and utilization of research are a necessary component of growth.
2. Ideally, the research cluster should be developed in a balanced community, balanced in all respects. There must be a mutual interaction between the various elements of the community, and it should not become an isolated provincial group of specialists who work for a single employer or are engaged in a single type of activity.
3. The degree of achievement that might be attained in any real community would depend upon the conditions existing in the specific community under consideration.

Recommendations:

It was recommended:

1. That a comprehensive, diagnostic study be made of the various communities of New York State in the light of their research potential; such study to be made, if possible, under the auspices of the Department of Commerce or this Council.
  - (a) The first phase of this study would be the development of community criteria which are important to the optimum research community development. One important aspect of the development of these criteria should be a study of areas, either in or outside the State, which have been successful as research capabilities, as well as communities that have been unsuccessful in this area. It is to be noted that the questionnaire previously utilized by the Council would be an important first part in the development of these criteria.
  - (b) This intense diagnostic study should be of areas of New York State, with particular emphasis to such items as the following:
    - (1) Local reaction and acceptance of change.
    - (2) Communication, transportation, and physical facilities of the community.
    - (3) The total labor market complex, not only professional but union labor across the board.
    - (4) Educational, recreational, and cultural resources of the community.
    - (5) Economic, political, and religious climate.
  - (c) The total community facilities should be carefully analyzed in respect to their impact and contribution to the research personnel as well as that of the community upon the personnel.

- (d) When a number of such areas in New York State have been thus identified, hopefully twenty-five to fifty, the Council should analyze what role can be played by the State agencies to encourage the development of such research and development facilities by private efforts in these selected areas.
- (e) The Council should also make an analysis of what can be done to encourage the utilization of results of such research organizations in the State's future economic growth.

#### PANEL IV

#### ECONOMIC PROBLEMS

Dr. Hector R. Skifter, Chairman

Basic Premises accepted were:

1. The overall subject matter of the Symposium is of crucial importance to the State of New York.
2. This is a period of most rapid technological change, and it must be obvious to anyone working in the newer fields that the industrial community ten to twenty years from now will be radically different in many ways than it is today.
3. Any group, be it a corporation, county, state, or country, that neglects to do the best planning it can toward that different environment will be left behind.
4. The foregoing is of overriding importance, warranting serious consideration of the final recommendations of the Liaison Panels by the government of the State of New York.

Recommendations:

It was recommended:

1. That it is necessary to "build an image" of the industrial and research advantages of New York State.
  - (a) This would include public education, public discussion, publicity, etc.

2. That it is necessary to understand and remedy the disadvantages in this area.
3. That, while it is important to concentrate on bringing new organizations into the State, effort must be made to create an atmosphere and environment in which the forward-looking companies already in the State will fully mature. The proper environment would make it possible for them to employ and keep the high grade of talent essential to their growth.
4. That the diagnostic study recommended by the Liaison Panel on Social Problems be continued.
5. That the government of the State of New York make available adequate funds to implement the planning leadership requisite in effecting the solution of the specific New York State problems.

The planning may include:

- (a) Regional conferences with respect to the impact on a community of the installation or growth of a company within it; and
- (b) Regional conferences on the problem of land utilization.

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